NET SAFETY MONITORING INC.

MILLENNIUM II
Combustible Gas Sensor

Catalytic Bead Sensor
User Manual

Model: SC310X-100-ASSY

ISO 9001:2000

QMI REGISTERED

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TABLE OF CONTENTS

INTRODUCTION **5**

THE PRODUCT *5*

THE MANUAL *5*

Transmitter and Sensor Enclosure Dimensions 6

SECTION 1: Plan **7**

1.1 Locate Sensor *7*

1.2 Sensor Non-Separated/direct mounting *7*

1.3 Sensor Separated/remote mounting *7*

SECTION 2: Installation **8**

2.1 Unpack *8*

2.2 Mount *8*

2.3 Wiring *8*

2.3.1 Field Installation 8

Earth Grounding *8*

2.3.2 Sensor Wiring 9

2.3.3 Installation Checklist 9

SECTION 3: Operation **10**

3.1 Configuration Settings *10*

3.2 Sensor Power Up *10*

3.3 Sensor Communication *10*

3.4 SensorGuard *10*

SECTION 4: Output **11**

4.1 Alarm and Fault Outputs *11*

4.1.1 Other Available Outputs 11

4.1.2 Modbus registers 11

SECTION 5: Maintaining **12**

5.1 Calibration Procedure *12*

5.1.1 Calibrating with the Millennium II Basic Transmitter. 12

5.1.2 Calibrating with the Millennium II Transmitter 16

5.1.3 Cross sensitivity 20

5.2 Sensor Replacement Procedure *20*

5.3 Troubleshooting *21*

5.4 Storage *21*

5.5 Spare Parts / Accessories *21*

5.6 How to Return Equipment *22*

Appendix **23**
Appendix A: Electrostatic Sensitive Device (ESD) *23*
Appendix B: Resistance Table *24*
Appendix C: Millennium II Catalytic Bead Sensor Specifications *25*

INTRODUCTION

Catalytic Bead (SC310) combustible gas sensors are designed specifically for use with any Millennium II series transmitters. These state of the art "Smart" sensors are both versatile and reliable for fast, accurate and continuous monitoring of gases in extreme environments.

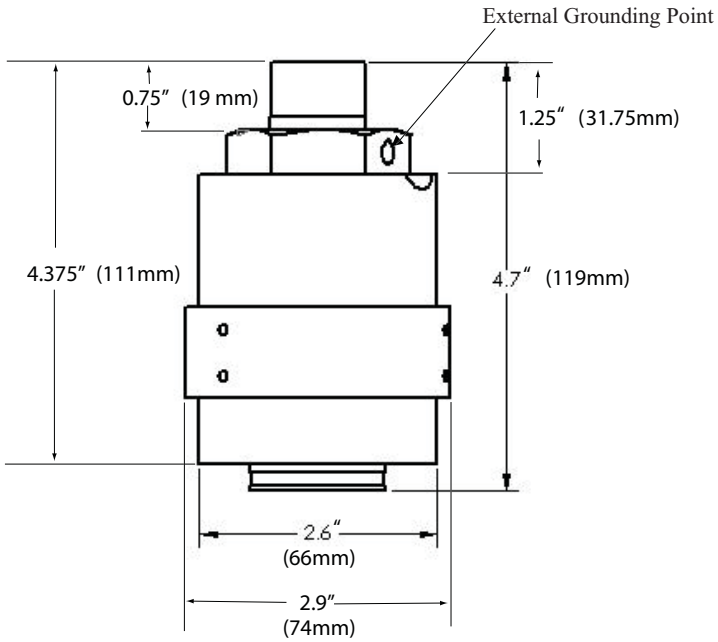
THE PRODUCT

The sensor assembly consists of a factory sealed explosion proof enclosure (housing) rated for hazardous locations and a replaceable combustible sensor module. This sensor should only be used with the Millennium II series transmitters (**Millennium II Basic Transmitter and the Millennium II Transmitter**). If the sensor is connected to any other model transmitter, it will not function and may result in the sensor being damaged.

THE MANUAL

This manual has been designed to ensure the sensor is set-up, operated and maintained properly**. It outlines specific details of the Catalytic Bead sensor and addresses calibration procedures using the Millennium II Basic Transmitter and the Millennium II Transmitter**. If you encounter any problems, see the troubleshooting section of this manual or contact your local representative.

Figure 1: Sensor Dimensional Drawing
Measurements are in inches and millimeters (mm).



Transmitter and Sensor Enclosure Dimensions

The tables below give the enclosure (housing) dimensions of the Millennium II Transmitter with sensor and Millennium II Basic Transmitter with sensor. Both transmitter and sensor enclosures are offered in Aluminum (AL) and Stainless Steel (SS).

Table 1: Millennium II enclosure and sensor dimensions (A through H) in Inches(in) and Millimeters(mm)

Millennium II transmitter enclosure	A		B		C		D		E		F		G		H	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Transmitter & sensor(AL)	6.3	160	5.6	142	5.4	137	9.7	246	6.0	152	5.7	145	2.6	66	2.9	74
Transmitter & sensor(SS)	5.9	150	5.1	130	4.6	117	8.9	226	6.0	152	5.8	147	2.6	66	2.9	74

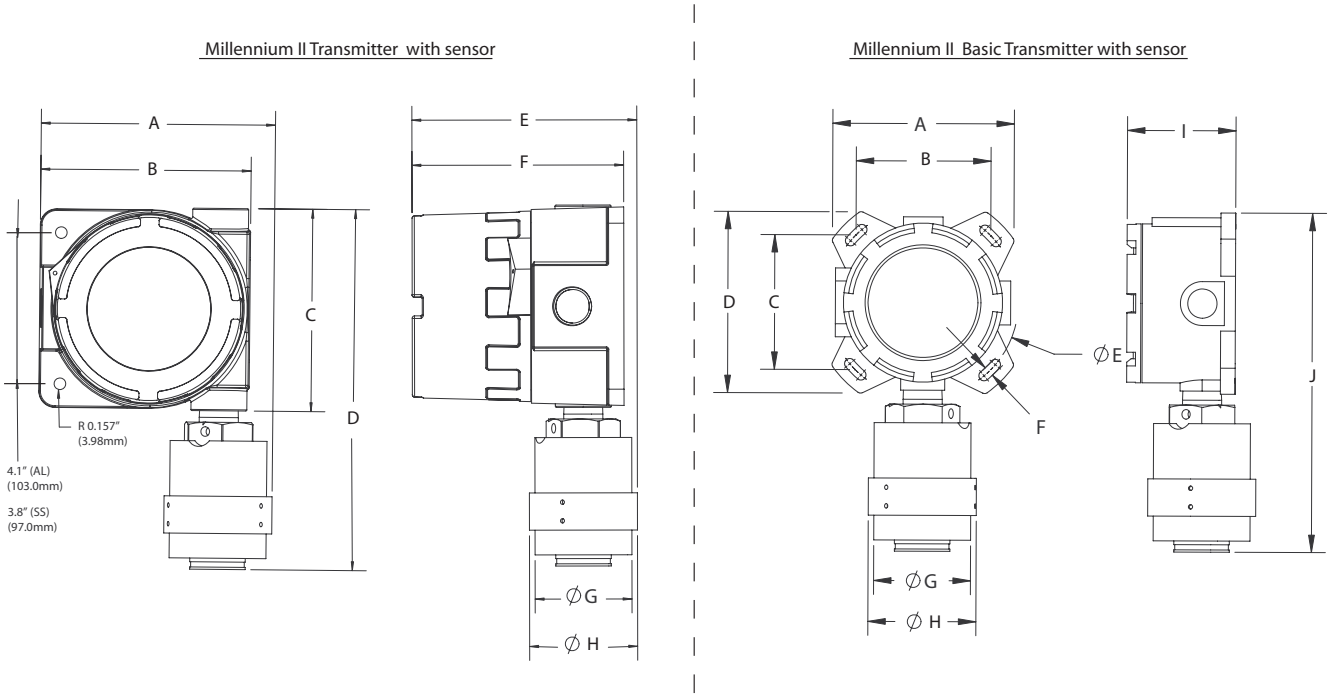
Table 2: Millennium II Basic enclosure (or junction box enclosure) and sensor dimensions (A through J) in Inches(in) and Millimeters(mm)

Millennium II Basic & sensor	A		B		C		D		E		F		G		H	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Transmitter & sensor(AL)	4.8	122	3.6	91	3.6	91	4.8	122	5.1	130	0.3	7.6	2.6	66	2.9	74
Transmitter & sensor(SS)	4.7	119	3.6	91	3.6	91	4.7	119	5.1	130	0.3	7.6	2.6	66	2.9	74

Table 2(cont'd)

Millennium II Basic & sensor	I		J	
	in	mm	in	mm
Transmitter & sensor(AL)	3.0	76	9.0	229
Transmitter & sensor(SS)	2.8	71	8.9	226

Figure 2: Dimensional drawing for sensor with Millennium II series transmitters



SECTION 1: Plan

1.1 Locate Sensor

Prior to the installation process, a plan should be developed for placement of the sensor. Although there are no absolute rules determining the quantity of detectors or location of a sensor, the following points should be considered when planning the installation.

- Carefully locate the sensor in an area where gases may potentially accumulate. (Remember, light gases tend to rise and heavy gases tend to accumulate in low areas).
- Use redundant systems to enhance protection and reliability.
- Consider the air movement patterns within the facility.
- Consider the construction of the facility such as trenches where heavy gases or peaks where light gases may accumulate.
- Seek advice from experts knowledgeable about the primary gas to be detected.
- Use common sense and refer to the regulatory publications that discuss guidelines for your industry.

1.2 Sensor Non-Separated/direct mounting

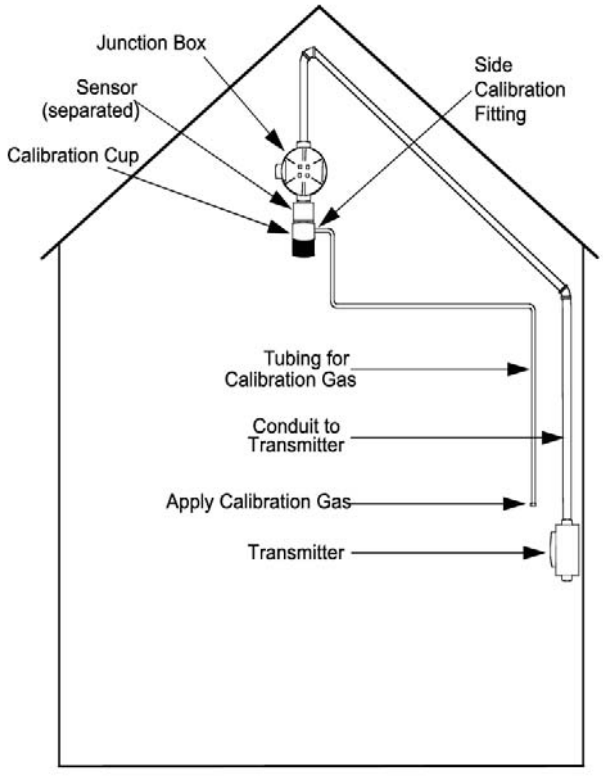
The sensor is attached directly to a transmitter and placed in the appropriate location for detecting the gas in question (target gas).

1.3 Sensor Separated/remote mounting

The sensor should always be connected to a certified junction box when separated from transmitter. The transmitter is located near eye-level for easy access and the sensor is mounted where gas is likely to accumulate. A calibration cup is clipped onto the bottom of the sensor enclosure and the calibration tubing is attached to the calibration cup and runs back to a convenient place for applying calibration gas, eliminating the need to access the sensor directly. Calibration gas can then be applied from ground level.

To compensate for the effect of distance when remotely calibrating, in separation configuration, decrease the tubing diameter or increase the calibration gas flow rate between the gas canister and sensor. On initial install, always confirm tubing run is not affecting calibration. Calibrate the sensor using tubing run and then confirm readings directly at sensor by applying calibration gas and comparing the output results. Readings should be accurate to the calibration gas concentration used.

Figure 3: Locating Sensor



SECTION 2: Installation

2.1 Unpack

Carefully remove all the components from the packaging and check them against the enclosed packing list. Inspect all components for any obvious damage such as broken or loose parts. If you find any components missing or damaged, notify your local Net Safety representative or the factory immediately.

2.2 Mount

Warning ⚠ Never install the sensor pointing upwards.

Recommendation: The sensor should be installed pointing downwards.

The sensor is mounted directly to either transmitter enclosure or to a separation junction box enclosure through a ¾" NPT conduit entry. Both the transmitter and junction box enclosures have mounting holes to allow mounting to a wall or pole as desired. Mounting kit hardware is required when mounting to a pole. Contact your local Net Safety Representative for detailed information on mounting kits.

2.3 Wiring

2.3.1 Field Installation

Warning ⚠ Wiring codes and regulations may vary. ATEX requires that supply connection wiring must be rated at least 5°C above the maximum ambient temperature of 85°C. Wiring must comply with all applicable regulations relating to the installation of electrical equipment in a hazardous area and is the responsibility of the installer. If in doubt, consult a qualified official before wiring the system.

Guidelines

When separating sensor from transmitter, the use of shielded cable is highly recommended for sensor wiring to protect against interference caused by extraneous electrical or electromagnetic 'noise'. To meet IEC 61000-1, IEC 61000-4 EMI, follow recommendations on cable choice and guidelines in the specific Millennium II series transmitter manual (MAN-0082 or MAN-0076). In applications where the wiring is installed in conduit, the conduit must not be used for wiring to other electrical equipment.

The maximum distance between the sensor and transmitter is limited by the resistance of the connecting wiring, which is a function of the gauge of the wire being used. Net Safety recommends that sensor separation distance should not be more than 2000 ft with 16 AWG wire. See Appendix B for wire gauges and resistance values.

Earth Grounding

An external ground is required. One method is to connect the external ground to the grounding point on the enclosure. See Figure 1 for grounding connection location.

Conduit Entry

Sensors are mounted directly to transmitters via ¾" NPT conduit entries through which wires are connected to terminals. Sensors may also be mounted remotely from transmitters using certified junction boxes with designated terminals. Transmitter and junction box enclosures are shipped with one stopping plug fitted and tightened to a ¾" NPT conduit entry.

2.3.2 Sensor Wiring

Warning ⚠ Do not open enclosures in a classified area (Do not open when an explosive atmosphere may be present). Ensure the power to the transmitter is switched off before connecting sensor wires.

Warning ⚠ Avoid touching electronic components, as they are susceptible to electrostatic discharge (ESD). Refer to Appendix A, "Electrostatic Sensitive Device (ESD)".

Connect sensor wires to the sensor terminals in the applicable transmitter. Refer to the Table 3 for sensor terminal definitions.

Table 3: Sensor wires and Millennium II series Terminal definitions

Sensor Terminals	Sensor Wire	White	Red	Blue	Black	Green
	Marked	+Vdc	Sig A	Sig B	COM	
	Function	10.5 - 32Vdc	A	B	Common/Supply Ground	Earth Ground

NOTE: When separating sensor from transmitter using **Net Safety separation kit, refer to Multi-purpose Junction Box Manual (MAN-0081)** for terminal designations. Always ensure that the transmitter is supplying the required voltage across sensor power terminals inside junction box. Refer to table above for sensor voltage requirements.

2.3.3 Installation Checklist

Prior to operation, it is important to do the following:

- Ensure transmitter and sensor are properly and firmly mounted.
- Ensure that stopping plug is tightened to unused conduit entry.
- Ensure transmitter and sensor are not being obstructed; transmitter and sensor are accessible and target gas is not inhibited from reaching sensor.
- Remove sensor red protective plastic cap/cover from sensor mouth.
- If IP filters are being used/fitted to sensor, check for damage or debris. Refer to specific IP filter instruction guide (MAN-0109).
- If calibration cup (splash guard) is being used/fitted to sensor, ensure a snug fit.
- Ensure adherence to applicable local guidelines and requirements on wiring and sealing of equipment in hazardous and non-hazardous areas.
- Ensure that proper shielding and grounding practices are adhered to, and local codes are being followed.
- Check system operational voltage and conditions. See Table 3 and Appendix C.
- Check wiring at all termination and junction points; wiring at transmitter terminals, junction box and at power supply. See Table 3 above and specific transmitter manual.

SECTION 3: Operation

3.1 Configuration Settings

All configuration settings are accessed through the Millennium II series transmitters. This is done by setting DIP switches on the Millennium II Basic Transmitter and by selecting menu options in the Millennium II Transmitter. Some configurations are done by the HART communicator on Analog /HART transmitter models. Refer to Section '5.1.1: Calibrating with the Millennium II Basic Transmitter' and Section '5.1.2: Calibrating with the Millennium II Transmitter' for information on selecting the target gas. Also see the relevant transmitter manual for information on Modbus settings.

3.2 Sensor Power Up

When power is applied to sensors by transmitters, a 30 second warm-up routine will begin, whereby sensors are automatically tested to ensure proper functioning. Refer to the Millennium II Basic Transmitter manual (MAN-0082) or the Millennium II Transmitter manual (MAN-0076) for status indications during this period. It is recommended that these sensors be powered up for 24 hours prior to the first calibration.

3.3 Sensor Communication

SC310 sensors use a proprietary protocol to communicate with the Millennium II series transmitters. These sensors should never be connected to any device other than the Millennium II series transmitters. Selected DIP switches and menu options allow communication between transmitters and sensors. Configuration settings are stored in the sensor's memory. Incorrect settings will cause sensors not to communicate properly with transmitters. If any problems develop see troubleshooting section.

3.4 SensorGuard

SensorGuard is a proprietary firmware feature that protects the pellistor sensor from the damage and/or response shift commonly caused by exposure to high concentrations of combustible gas. With this feature, repeated or lengthy exposure to high gas concentrations has negligible effect on sensor performance. Sensor life is prolonged and calibration frequency is reduced. This does not eliminate the necessity of periodic sensor response checks which should be performed as part of an effective maintenance schedule.

If a gas signal exceeds 100% LEL, the Millennium II series transmitters will latch the output of the sensor at 20 mA and the display of the Millennium II Transmitter will flash '100% LEL' continually until power is recycled or a manual reset is initiated. Refer to 'manual reset' in the Millennium II Basic Transmitter manual (MAN-0082) or the Millennium II Transmitter manual (MAN-0076).

If the gas signal exceeds 105% LEL, the sensor will deactivate the sensing element to protect it from extreme drift or damage caused by high gas concentrations. This protective feature extends the useful lifetime of the sensor and reduces or eliminates disruption of its calibration. As an extra safety precaution, the system should be checked for accuracy after such over-range exposure and if necessary re-calibrated. The system will need to be reset to clear the latched output.

SECTION 4: Output

4.1 Alarm and Fault Outputs

Sensor alarm and fault outputs are generated by the Millennium II series transmitters based on communication with sensors, however some output values, registers, etc, may vary depending on sensor type. **The default alarm levels (point) for the sensor are**: **20 % for the low level and 40 % for the high level**.

4.1.1 Other Available Outputs

All available outputs are associated with the Millennium II series transmitters. These outputs are: 4-20 mA output, Relay output, RS 485 Modbus (RTU) output and HART Communication output. Refer to the Millennium II Basic Transmitter manual (MAN-0082) or the Millennium II Transmitter manual (MAN-0076) for more information.

4.1.2 Modbus registers

Table 4 below, shows the user accessible Modbus registers and meaning.

Table 4: Modbus registers and meaning

Reg #	Meaning	Readable	Writeable
40001	Concentration value as calculated by sensor	X	
40002	Sensor status	X	
40003	Sensor Temperature	X	
40101	Resets the sensor		X
40102	Initialize zero & span *(**to calibrate sensor, enter channel #)***		X
40104	Zero only *(**to zero sensor, enter channel #)***		X

* **Note**: For the Millennium II Basic Transmitter enter ‘1’ in register 40102 to calibrate the sensor and ‘1’ in register 40104 to zero the sensor.

SECTION 5: Maintaining

5.1 Calibration Procedure

There are specific steps to be followed when calibrating with the Millennium II Basic and the Millennium II Transmitters. These steps should be followed if accurate results are to be obtained. The calibration of Catalytic Bead sensors requires the presence of oxygen. **An air balanced calibration gas should be used for calibration**, otherwise these sensors will not calibrate properly. It is recommended that these sensors be calibrated every 3 months (90 days) to ensure proper functioning.

5.1.1 Calibrating with the Millennium II Basic Transmitter.

When a Catalytic Bead sensor is fitted to a Millennium II Basic Transmitter, the default setting of the transmitter's DIP Switch 2 Positions is as follows: **Position 1 ON and Positions 2, 3 and 4 all OFF. These DIP Switch positions should not be altered**. When calibrating, follow the normal calibration procedure below **using 50% span of the specific LEL gas to be detected (target gas) for calibrations.** If calibration is not successful perform a manual reset. See Millennium II Basic Manual (MAN-0082) for manual reset.

Methane as calibration gas:
If only Methane gas is available as calibration gas, then a specific Correction Factor ("K Factor") relating to the target gas (non-Methane) has to be manually entered using the HART Communicator. This feature is only available on Analog/HART Transmitter Models. The appropriate Correction Factor is dependent on the Lower Explosive Limit (LEL) of the desired target gas as specified by the performance standard(s) applicable at the installation site. Table 5 and Table 6 provide Correction Factors for common gases and their respective LEL values. **Use 50% span Methane gas with the appropriate % by volume as indicated below.**

The tables below outline the primary detectable gases of the sensor. Multiple other gases are however, detectable. Please contact your representative regarding any gases not included in tables below.

Table 5: K-Factors for ISA (N. American) LEL values (Calibrate with 2.5% by volume Methane)

Gas	LEL	Correction Factor
Propane	2.1% Volume	1.8
n-Butane	1.8% Volume	2.0
Isobutylene	1.8% Volume	2.1
Hydrogen	4.0% Volume	1.2
Ethane	3.0% Volume	1.4
Pentane	1.4% Volume	2.2
Hexane	1.2% Volume	2.3
Heptane	1.1% Volume	2.7
Ethylene	2.7% Volume	1.5
Propylene	2.4% Volume	1.5
Methanol	6.7% Volume	1.2
Ethanol	3.3% Volume	1.7

Table 6: K-Factors for IEC (European) LEL values (Calibrate with 2.2% by volume Methane)

Gas	LEL	Correction Factor
Propane	1.7% Volume	2.0
n-Butane	1.4% Volume	1.9
Isobutylene	1.8% Volume	1.7
Hydrogen	4.0% Volume	1.2
Ethane	2.5% Volume	1.5
Pentane	1.4% Volume	1.9
Hexane	1.0% Volume	2.5
Heptane	1.1% Volume	2.4
Ethylene	2.3% Volume	1.6
Propylene	2.0% Volume	1.6
Methanol	5.5% Volume	1.3
Ethanol	3.1% Volume	1.6

Note: For other gases and Correction Factors, please contact the manufacturer (factory).

If the sensor's configuration setting is setup correctly as desired, **refer to Millennium II Basic Transmitter calibration procedure below and/or Figure 4 before attempting calibration.**

Millennium II Basic Transmitter Normal Calibration Procedure:

Calibrations may be performed either by using the magnet (non – intrusive) or by using the push button (intrusive).

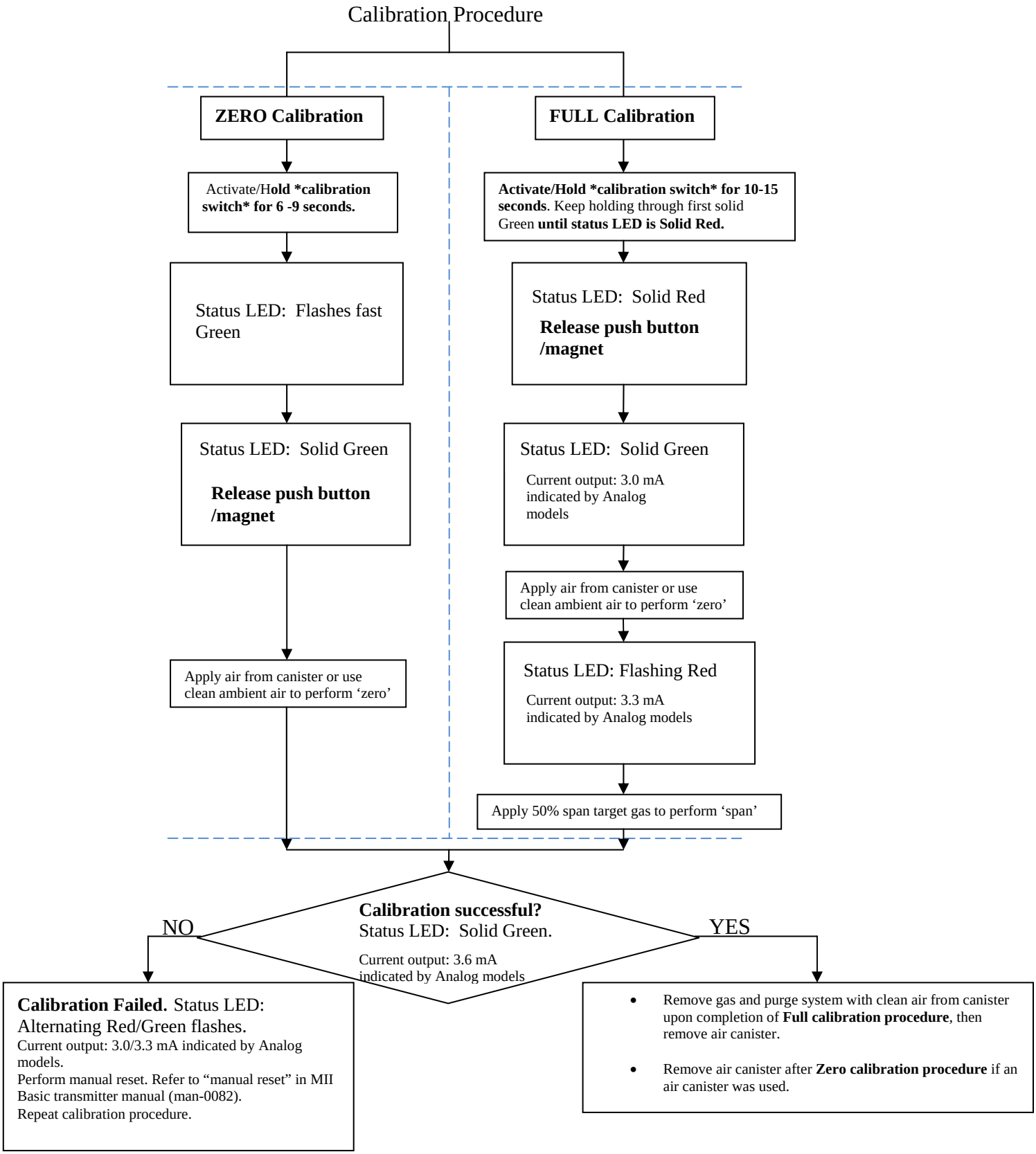
1. Confirm successful power up of Transmitter, (green blip/blink of status LED every second: no fault indicated).
2. Bypass any output alarms (recommended).
3. For analog model connect a standard current meter to the transmitter's Test Jacks (not required but gives visual confirmation).
4. Press and hold the "**push button**" (or activate the "**Reed switch**" using the magnet) for at least 15 seconds, the status LED flashes green fast, and then goes solid green (first solid green). Keep holding "**push button**" or magnet, after which, status LED goes solid red. When this occurs, release "**push button**" or remove magnet.
5. When the current output is 3 mA (indicated by analog models) and the Status LED is once again solid green (second solid green), apply zero gas (clean air). **Recommendation**: Flow ZERO AIR at a rate of 0.5 liter per minute or more to the sensor.
6. When the current output is 3.3 mA (indicated by analog models) and the Status LED is flashing red, apply specific calibration gas (50% of full span). **Recommendation**: Flow span gas at a rate of 0.5 liter per minute to the sensor for direct sensor calibrations. If sensor is remotely mounted and long tubing run is used, increase gas flow rate (e.g.1.0 liter per minute) to ensure tubing length does not affect calibration results.
7. When the current output is 3.6 mA (indicated by analog models) and the Status LED is solid green, remove the gas.
8. Apply zero gas (clean air) again to purge the system.
9. After the sensor is purged of gas, the detector will return to normal operation.

Note: When calibrating with the **Millennium II Basic Transmitter always use 50% span gas (half the scale)**. **Calibration gas MUST be air balanced for SC310 sensors**. Calibration instructions are also accessed using the HART Communicator with the Analog/HART model transmitter. For HART Menu Structure/Tree, see Millennium II Basic transmitter manual (MAN-0082).

Zero Calibration Option:
This option is useful if the sensor's zero point has drifted as a result of a change in the ambient conditions. The ***"Zero"* calibration option** is selected if a sensor is only being zeroed (this not a complete calibration). The application of span gas is not required, as only the sensor's zero point is adjusted. Ensure that no contaminants are present, if the surrounding air is to be used for Zeroing. If Zero calibration is needed, at step 4 above, hold the push button or activate Reed switch (for 6-9 seconds) using the magnet, until the status LED goes solid green, and then release the switch. Zero calibration will begin immediately.

See Figure 4: Calibration Flow chart for Millennium II Basic Transmitter on next page for additional reference.

Figure 4: Calibration Flow chart for Millennium II Basic Transmitter


Calibration Procedure
ZERO Calibration
FULL Calibration
Activate/Hold *calibration switch* for 6 -9 seconds.
Activate/Hold *calibration switch* for 10-15 seconds. Keep holding through first solid Green until status LED is Solid Red.
Status LED: Flashes fast Green
Status LED: Solid Red
Release push button /magnet
Status LED: Solid Green
Release push button /magnet
Status LED: Solid Green
Current output: 3.0 mA indicated by Analog models
Apply air from canister or use clean ambient air to perform 'zero'
Apply air from canister or use clean ambient air to perform 'zero'
Status LED: Flashing Red
Current output: 3.3 mA indicated by Analog models
Apply 50% span target gas to perform 'span'
NO
Calibration successful?
Status LED: Solid Green.
Current output: 3.6 mA indicated by Analog models
YES
Calibration Failed. Status LED: Alternating Red/Green flashes.
Current output: 3.0/3.3 mA indicated by Analog models.
Perform manual reset. Refer to "manual reset" in MII Basic transmitter manual (man-0082).
Repeat calibration procedure.
Remove gas and purge system with clean air from canister upon completion of Full calibration procedure, then remove air canister.
Remove air canister after Zero calibration procedure if an air canister was used.

Note: * See the Millennium II Basic transmitter manual (MAN-0082) when locating calibration switch (push button) or magnetic switch.

5.1.2 Calibrating with the Millennium II Transmitter.

The following procedures are specific to this controller and should be followed to ensure accurate calibration and detection of gases. The transmitter also offers some flexibility in the use of calibration gas. If the calibration gas available is not 50% span gas, the transmitter will allow calibration to be performed with calibration gas within the range of 10- 60% span gas. For the most accurate calibration however, the calibration gas value should be within 40-60% of the full scale range. To select the calibration gas value, enter the transmitter's main menu and select *'cal. gas value'* and enter the value. Refer to MAN-0076 when navigating through menu options.

Configuration for the target calibration gas:

If a calibration gas cylinder of the desired target gas (Methane or otherwise) is available, refer to the steps below to first configure the sensor for the target gas.

1. Enter the Main menu, first by pressing any key to get the *"enter main menu"* prompt, then press ***menu button 1***(***Reed switch 1***) to select *"yes."*

2. Select the up arrow key (***menu button 1*** or ***Reed switch 1***) or down arrow key (***menu button 2 or Reed switch 2)***, until "*Select Gas Type"* option is displayed.

3. Select the enter key (***Menu button 3*** or ***Reed switch 3***) to enter the option and ensure the default setting, *CH1: No correction* & *CH2: No correction* is being displayed, then exit and proceed to the calibration procedure; calibrate with the specific target gas (detectable gases listed in Table 5 or Table 6).

4. If the "*custom"* option is being displayed at step 3, select ***Menu button 3*** or ***Reed switch 3*** and then use ***Menu button 2 or Reed switch 2*** to navigate to "*No correction"*. Select *"No correction"* option with ***Menu button 3*** or ***Reed switch 3***.

5. Use the navigation keys along with ***Menu button 3 or Reed switch*** 3until the main menu is completely exited.

Note: Use the specific gas to be detected (with the same calibration value as that selected in the transmitter's menu under "*Cal. gas value"*) for calibrating the sensor.

Configuration for Methane as the calibration gas:

If only methane is available as calibration gas, then select "*Custom"* in the controller's main menu under *'select gas type'*. Enter the specific K-Factor from Table 5 or Table 6 above. Follow the steps below in entering K Factor.

1. Enter the Main menu, first by pressing any key to get the *"enter main menu"* prompt, then press ***menu button 1***(***Reed switch 1***) to select *"yes."*

2. Select the up arrow key (***menu button 1*** or ***Reed switch 1***) or down arrow key (***menu button 2 or Reed switch 2)***, until "*Select Gas Type"* option is displayed.

3. Select ***Menu button 3*** or ***Reed switch 3*** then use and ***Menu button 2 or Reed switch 2*** to navigate to "*Custom"*. Select "*Custom"* with ***Menu button 3*** or ***Reed switch 3.***

4. To configure the K Factor option/sub menu, select ***Menu button 3*** or ***Reed switch 3*** again.

5. *"Enter K Factor"* will be displayed with an existing K-Factor value. Use ***menu button 1*** or ***Reed switch 1*** to increase the displayed digits and use (***menu button 2 or Reed switch2)*** to navigate across digits.

6. When the desired K Factor value is entered as desired (taken from Table 5 or Table 6), exit by selecting "*Exit*" with ***Menu button 3 or Reed switch 3.***

7. Use the navigation keys along with ***Menu button 3 or Reed switch*** 3 until the main menu is completely exited.

Note: Use the available Methane gas (with the same calibration value as that selected in the transmitter menu under *Cal. gas value*) for calibration the sensor.

Refer to Millennium II Transmitter calibration procedure below and/or Figure 5 before attempting calibration.

Millennium II Transmitter Normal (Full) Calibration Procedure:

If the sensor's configuration setting is setup correctly as desired, follow the steps below for Full Calibration / Normal Calibration Procedure. Note that if a calibration is not successful the message *"Span failed"* will be displayed and a manual reset will have to be initiated. Refer to Millennium II Transmitter manual (MAN-0076) for manual reset.

1. Enter the main menu, first by pressing any key to get the *"enter main menu"* prompt, then press/select ***menu button 1*** or ***Reed switch 1*** to select *"yes."*

2. When *"Calibrate Sensor?"* is displayed, select the enter key (***menu button 3*** or ***Reed switch 3***).

3. When *"Calibrate Sensor #1?"* is highlighted, press the enter key (***menu button 3*** or ***Reed switch 3***) if this is the sensor to be calibrated or,

4. If Sensor #2 is to be calibrated, select the down arrow key (***menu button 2*** or ***Reed switch 2***) to scroll to *"Calibrate Sensor #2?"*

5. When the desired sensor to be calibrated (1 or 2) is highlighted, activate the enter key (***menu button 3*** or ***Reed switch 3)***.

6. Select *"YES"* (***menu button 1*** or ***Reed Switch 1***) to confirm the selection.

7. Apply clean air when *"Apply Clean Air"* is displayed, then select *"Z & Span"* using (***menu button 1*** or ***Reed Switch 1***) for normal calibration. *"Setting zero"* will be displayed as the sensor is being zeroed. (Ensure no contaminant gases are present if ambient air is being used).

8. Apply 50% calibration gas (or *% Cal. gas value* chosen in menu option) when prompted.
Recommendation: Flow span gas at a rate of 0.5 liter per minute to the sensor for direct calibrations. If sensor is remotely mounted and long tubing run is used, increase gas flow rate (e.g. 1.0 liter per minute) to ensure tubing length does not affect calibration results.

9. The display will show *"Spanning"* with the gas value (%LEL) as the gas is detected.

10. Remove the calibration gas when *"Remove Cal Gas"* is displayed.

11. *"Cal Complete"* will be displayed when calibration is complete.

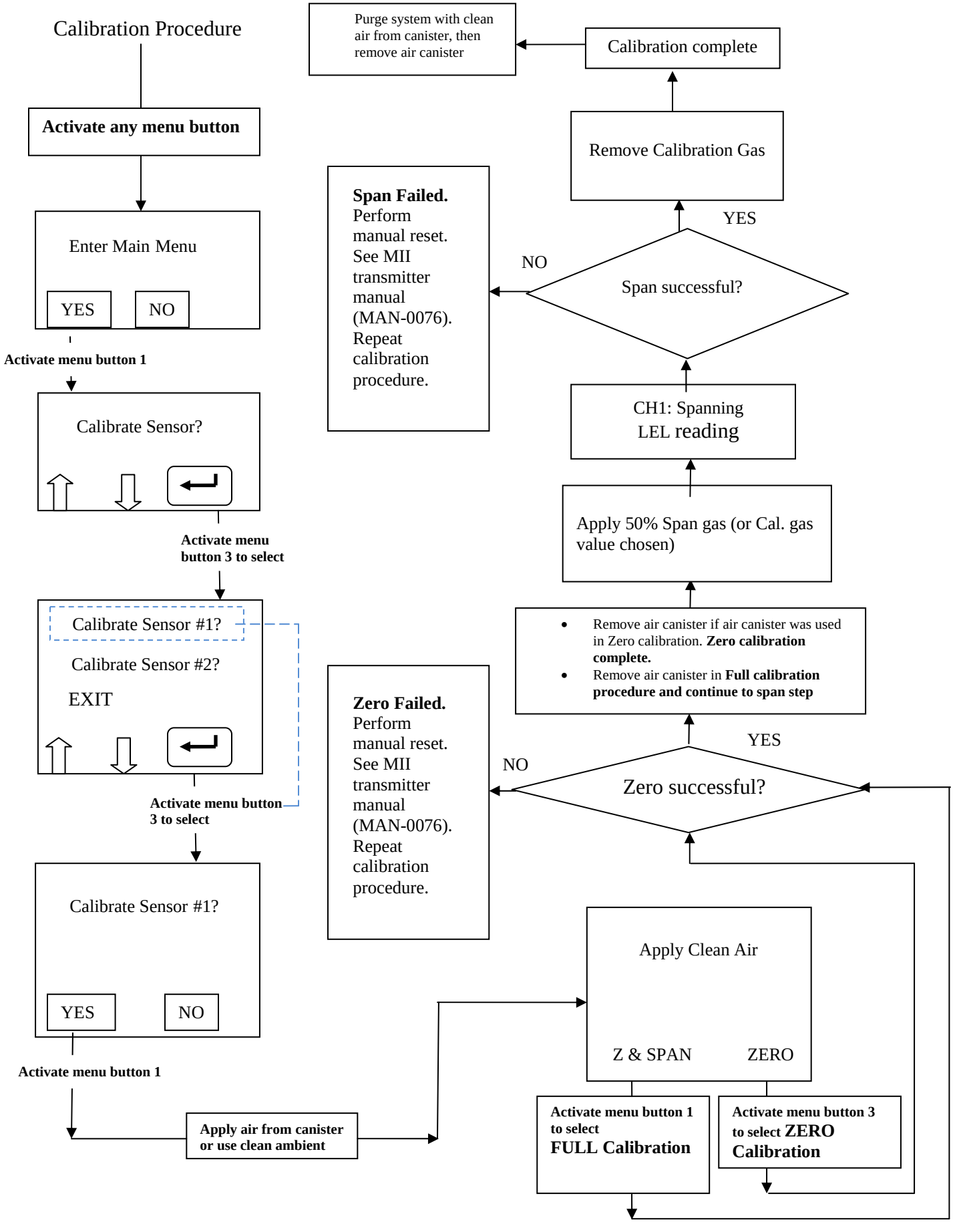
12. Apply zero gas (clean air) to purge system.

Note: Calibration gas **MUST** be air balanced. Calibration instructions are also accessed using the HART Communicator with the single channel Millennium II Transmitter model.

Zero Calibration Option:
This option is useful if the sensor's zero point has drifted as a result of a change in the ambient conditions. The ***"Zero"* calibration option** is selected if the sensor is only being zeroed (this not a complete calibration) It does not require the application of span gas, as only the sensor's zero point is adjusted. Ensure that no contaminants are present, if the surrounding air is to be used for Zeroing. If Zero calibration is needed, at step 7 above, select '*Zero'* using (***menu button 3*** or ***Reed Switch 3***) and use clean ambient air or air from canister to calibrate.

See Figure 5: Calibration Flow chart for Millennium II Transmitter on next page for additional reference. The chart shows calibration steps for channel 1. Calibration steps for channel 2 are similar.

Figure 5: Calibration Flow chart for Millennium II Transmitter


Calibration Procedure
Activate any menu button
Enter Main Menu
YES
NO
Activate menu button 1
Calibrate Sensor?
Activate menu button 3 to select
Calibrate Sensor #1?
Calibrate Sensor #2?
EXIT
Activate menu button 3 to select
Calibrate Sensor #1?
YES
NO
Activate menu button 1
Apply air from canister or use clean ambient
Apply Clean Air
Z & SPAN
ZERO
Activate menu button 1 to select FULL Calibration
Activate menu button 3 to select ZERO Calibration
Zero successful?
NO
YES
Zero Failed. Perform manual reset. See MII transmitter manual (MAN-0076). Repeat calibration procedure.
Remove air canister if air canister was used in Zero calibration. Zero calibration complete.
Remove air canister in Full calibration procedure and continue to span step
Apply 50% Span gas (or Cal. gas value chosen)
CH1: Spanning LEL reading
Span successful?
NO
YES
Span Failed. Perform manual reset. See MII transmitter manual (MAN-0076). Repeat calibration procedure.
Remove Calibration Gas
Calibration complete
Purge system with clean air from canister, then remove air canister

5.1.3 Cross sensitivity

The SC310 sensor will react to airborne materials that burn or explode in oxygen atmospheres, such as gaseous hydrocarbons. Certain compounds, including Halogen-containing hydrocarbons, can reduce sensor response. In some instances this reduction in response is reversible and the sensor will operate normally when such a compound or gas is removed. Exposure to organic phosphates, esters and Silicon-containing compounds will "poison" the sensor, resulting in an irreversible loss in sensitivity. For more information, please contact the manufacturer.

5.2 Sensor Replacement Procedure

Sensors are pre-calibrated at the factory but field calibration must be performed as part of commissioning. When a calibration can no longer be performed or the sensor is not operating properly the sensor module may need to be replaced. Refer to steps below for replacing sensor module.

Warning ⚠ Do not open enclosure in a classified area.

Note: Components are ESD sensitive, as a result all ESD rules and procedures should be observed. See Appendix A for ESD guidelines.

To replace the sensor module:

1. Remove power from sensor.
2. Remove the locking ring by loosening the set crews with 1.5 mm Allen Key tool.
3. Remove the bottom part of the sensor enclosure by turning in a counter clockwise rotation to expose sensor module.
4. Using the Teflon pull tab, pull sensor module straight down out of the sensor enclosure until it is completely removed from the enclosure.
5. Align replacement sensor module with pins inside top section of the enclosure base and push on outer plastic ring until sensor is seated properly. DO NOT PUSH ON CENTER ELEMENT.
6. Install and hand-tighten the bottom part of the sensor enclosure by turning in a clockwise direction.
7. Install the locking ring by tightening the set screws with 1.5 mm Allen Key tool.
8. Restore power to sensor via transmitter.

5.3 Troubleshooting

Sensors and controllers / transmitters are not designed to be repaired in the field. If problems should develop, first check for faulty wiring, confirm proper voltage to sensor, and attempt a calibration. If problems persist, please contact Net Safety's Service Department first by phone to try and resolve any issues. If issues cannot be resolved, please follow the procedure on next page, on 'how to return equipment.'

5.4 Storage

The sensor and its electronic components/parts should be stored in locations free from dust and moisture. The storage temperature should be well within the limits of the certified temperatures of the equipment. See Appendix C for certified temperatures.

5.5 Spare Parts / Accessories

Table 7: Available Spare Parts

Description	Net Safety Part Number
Calibration Cup / Splash Guard	CCS-1
Separation Kit	JB-MPD-A (aluminum) or JB-MPD-S (316 stainless steel)
Dust Filter Assembly	DSC-1
Replacement Cat Bead Sensor	SC310-100
IP66/67 Hydrophobic Filter	IPF-001

5.6 How to Return Equipment

A Material Return Authorization number is required in order to return equipment. Please contact Net Safety Monitoring at **(403) 219-0688**, before returning equipment or consult our Service Department to possibly avoid returning equipment.

If you are required to return equipment, include the following information:

1. A Material Return Authorization number (provided over the phone to you by Net Safety).
2. A detailed description of the problem. The more specific you are regarding the problem, the quicker our Service Department can determine and correct the problem.
3. A company name, contact name and telephone number.
4. A purchase order, from your company, authorizing repairs or request for quote.
5. Ship all equipment, prepaid to: **Net Safety Monitoring Inc.,**
   2721 Hopewell Place NE,
   Calgary, Alberta, Canada, T1Y 7J7
6. Mark all packages: **RETURN for REPAIR**.
7. Waybills, for shipment outside Canada, must state: **Equipment being returned for repair**
   All charges to be billed to the sender

Ensure a duplicate copy of the packing slip is enclosed inside the box indicating item 1 – 4 along with the courier and account number for returning the goods.

Pack items to protect them from damage and use anti-static bags or aluminum-backed cardboard as protection from electro-static discharge.

ALL equipment must be shipped prepaid. Collect shipments will not be accepted.

Appendix

Appendix A: Electrostatic Sensitive Device (ESD)

Definition: Electrostatic discharge (ESD) is the transfer, between bodies, of an electrostatic charge caused by direct contact or induced by an electrostatic field.

The most common cause of ESD is physical contact. Touching an object can cause a discharge of electrostatic energy—**ESD**! If the charge is sufficient and occurs near electronic components, it can damage or destroy those components. In some cases, damage is instantaneous and an immediate malfunction occurs. However, symptoms are not always immediate—performance may be marginal or seemingly normal for an indefinite period of time, followed by a sudden failure.

To eliminate potential ESD damage, review the following guidelines:

- Handle boards by metal shields—taking care not to touch electronic components.
- Wear grounded wrist or foot straps, ESD shoes or heel grounders to dissipate unwanted static energy.
- Prior to handling boards, dispel any charge in your body or equipment.
- Ensure all components are transported and stored in static safe packaging
- When returning boards, carefully package in the original carton and static protective wrapping
- Ensure **ALL** personnel are educated and trained in ESD Control Procedures

In general, exercise accepted and proven precautions normally observed when handling electrostatic sensitive devices. A warning label is placed on the packaging, identifying product using electrostatic sensitive semiconductor devices.

Appendix B: Resistance Table

Distance (Feet)	AWG #20 0.5mm^2	AWG #18 0.8mm^2	AWG #16 1.0mm^2	AWG #14 2.0mm^2
100	1.02	0.64	0.40	0.25
200	2.03	1.28	0.80	0.51
300	3.05	1.92	1.20	0.76
400	4.06	2.55	1.61	1.01
500	5.08	3.20	2.01	1.26
600	6.09	3.83	2.41	1.52
700	7.11	4.47	2.81	1.77
800	8.12	5.11	3.21	2.02
900	9.14	5.75	3.61	2.27
1000	10.20	6.39	4.02	2.53
1250	12.70	7.99	5.03	3.16
1500	15.20	9.58	6.02	3.79
1750	17.80	11.20	7.03	4.42
2000	20.30	12.80	8.03	5.05
2250	22.80	14.40	9.03	5.68
2500	25.40	16.00	10.00	6.31
3000	30.50	19.20	12.00	7.58
3500	35.50	22.40	14.10	8.84
4000	40.60	25.50	16.10	10.00
4500	45.70	28.70	18.10	11.40
5000	50.10	32.00	20.10	12.60
5500	55.80	35.10	22.10	13.91
6000	61.00	38.30	24.10	15.20
6500	66.00	41.50	26.10	16.40
7000	71.10	44.70	28.10	17.70
7500	76.10	47.90	30.10	19.00
8000	81.20	51.10	23.10	20.20
9000	91.40	57.50	36.10	22.70
10000	102.00	63.90	40.20	25.30

Resistance shown is one way. This figure should be doubled when determining closed loop resistance.

Appendix C: Millennium II Catalytic Bead Sensor Specifications

SENSOR	Catalytic Bead
Performance	
Power Consumption	(10.5 – 32 VDC) < 1.5WATT
Voltage Range	10.5 – 32 VDC
RFI, EMC, Immunity	RFI: 150 to 170 MHz and 450 to 470 MHz, 5W FM radio at 1 meter away; EMC: IEC 61000-1-4 and IEC 61000-4-3 Severity level 2
Response Time	T50 ≤ 5.5 sec T60 ≤ 6 sec T90 ≤ 12 sec
Zero Drift	+/- 2% per month
Repeatability	+/- 1% LEL
Environmental	
Temperature	Performance verified: -55°C to +85°C Certified: -40°C to +75°C.
RH	0 – 99% RH
Metallurgy	Aluminum (AL6061) or Stainless Steel (316 SS)
Nema / IP Rating	NEMA 4X / IP 64
Weight	Aluminum (AL6061) enclosure: 0.4kg/1.0lbs, Stainless Steel (SS316) enclosure: 1.4kg/3.5lbs
Separation	
Separation	Up to 2000 feet / 600 meters with 16 AWG wires
Approvals	
Approvals	FM C US APPROVED Performance certified to FM6310, FM6320, CSA 22.2 No. 152, IEC/EN61779-1, IEC/EN61779-4, ANSI/ISA-12.13.01 FM certification (Canada and US) Class 1, Div 1, Grps BCD, Zone 1, AEx/Ex d IIB+H2, T5, IP64, Type 4X FM ATEX: CE 0575 Ex II2 G Ex d IIB+H2, T5, IP64 FM07ATEX0012X

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http://www.net-safety.com/service/product_services.html

MAN-0084 Rev 4 Catalytic Bead Sensor
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